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EFFICIENCY OF THE FAST MULTIPOLE BEM WITH QUADRATIC ELEMENTS FOR 3D LINEAR ELASTICITY

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A Fast Multipole Boundary Element Method (FMBEM) computer code for 3D elasticity problems is developed. In contrast to other codes, e.g. [1], higher order boundary elements with quadratic shape functions, i.e. 8-node Serendipity elements, are applied to the discretization of geometry and boundary quantities. The numerical integration of boundary integrals, depending on Kelvin solutions, involves an adaptive subdivision of elements to provide a high accuracy of the calculations [2, 3]. The code is parallelized by the OpenMP standard to exploit the abilities of multi-core processors [4]. In the present work, the efficiency of the method is evaluated in terms of accuracy and model size by a comparison with Finite Element Method (FEM) models, with quadratic shape function elements. Models of different geometry, including porous material representative volume elements [4] and selected machine components with stress concentration, are analysed. For the analysed structures, both methods provide results with similar accuracy of few per cent. However, the FMBEM models have by an order of magnitude lower number of Degrees of Freedom compared to the FEM, as the number is $O(10^5)$ for the FMBEM and $O(10^6)$ for the FEM. Thus, the FMBEM can be competetive to the widely used FEM.

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